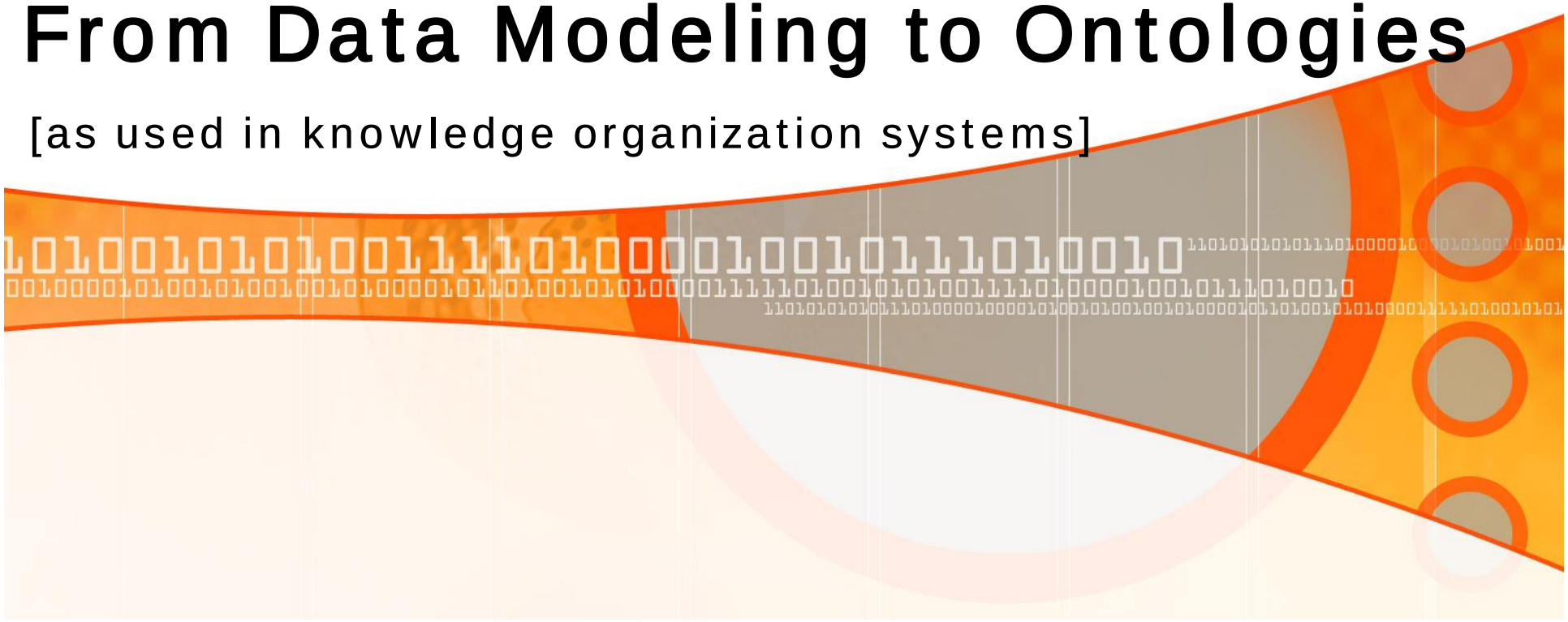
Marcia Lei Zeng
Second International Seminar on
Subject Access to Information, Helsinki,
Finland, 29-30 November 2007

# From Data Modeling to Ontologies

[as used in knowledge organization systems]



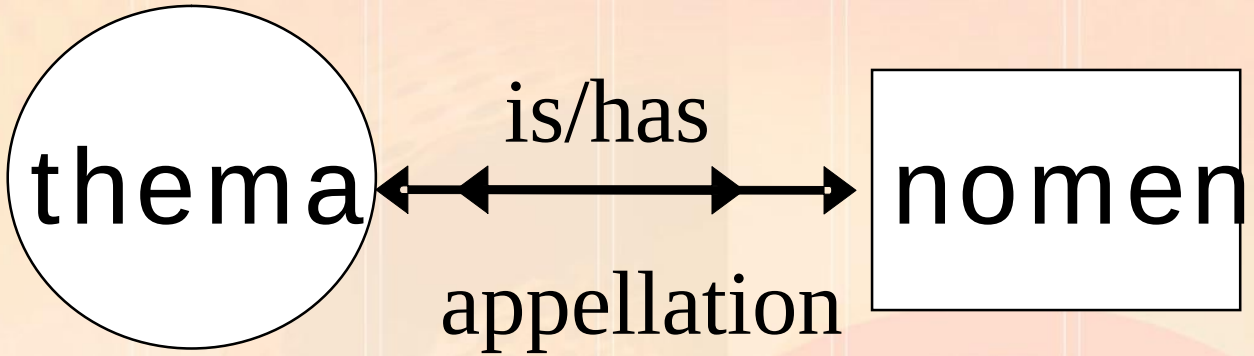
# New requirement

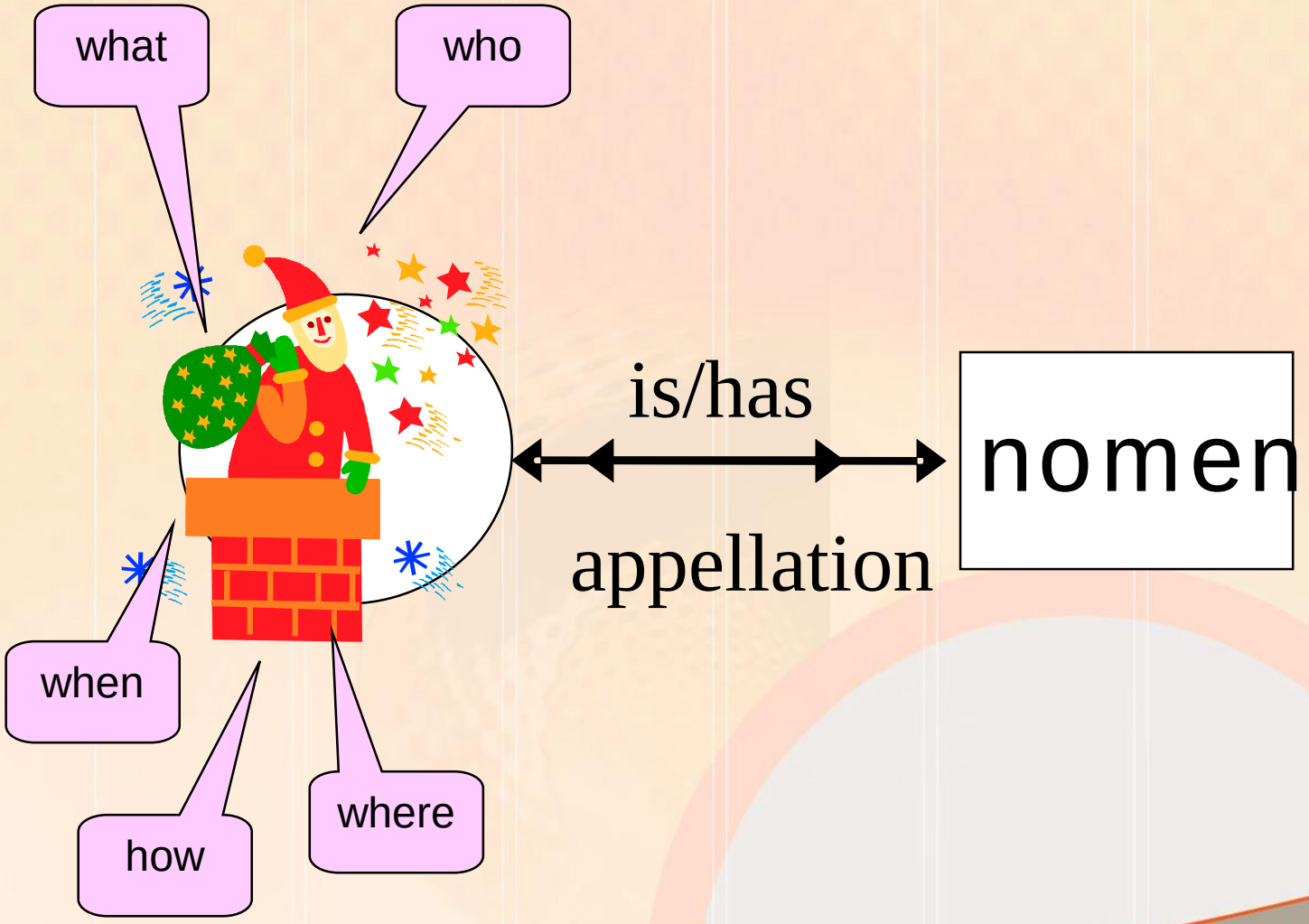
- Making KOS machine-processable (machine-understandable)
  - -- a concern previously belonged to the domain of researchers in computer science and W3C pioneers
  - -- now in library and information sciences
  - -- recommendation of LC WG on Future of Bibliographic Control (Nov. 13, 2007)

- Among the specific recommendations, one is to "Optimize LCSH for Use & Re-use"
  - de-coupling [LCSH] subject strings
  - making data (including subject authority data) directed to Web services in order to make them machine-processable
- All traditional KOS face such an issue which needs immediate action.
- However, there has been a lack of a conceptual model that could have been used across all KOS.

# Conceptual model of aboutness

- Models shown by Eeva Murtomaa and Maja Zumer for the FR-family:
  - FRAD
  - FRSAR
- A key concept here is to separate a [stuff] from what it is called, referred to, or addressed as


thema
is/has
appellation
nomen


what
who
when
how
where
is/has
appellation
nomen

# Putting it together: a thesaurus entry:

Term: Economic cooperation

Used For:
- Economic co-operation

Broader terms:
- Economic policy

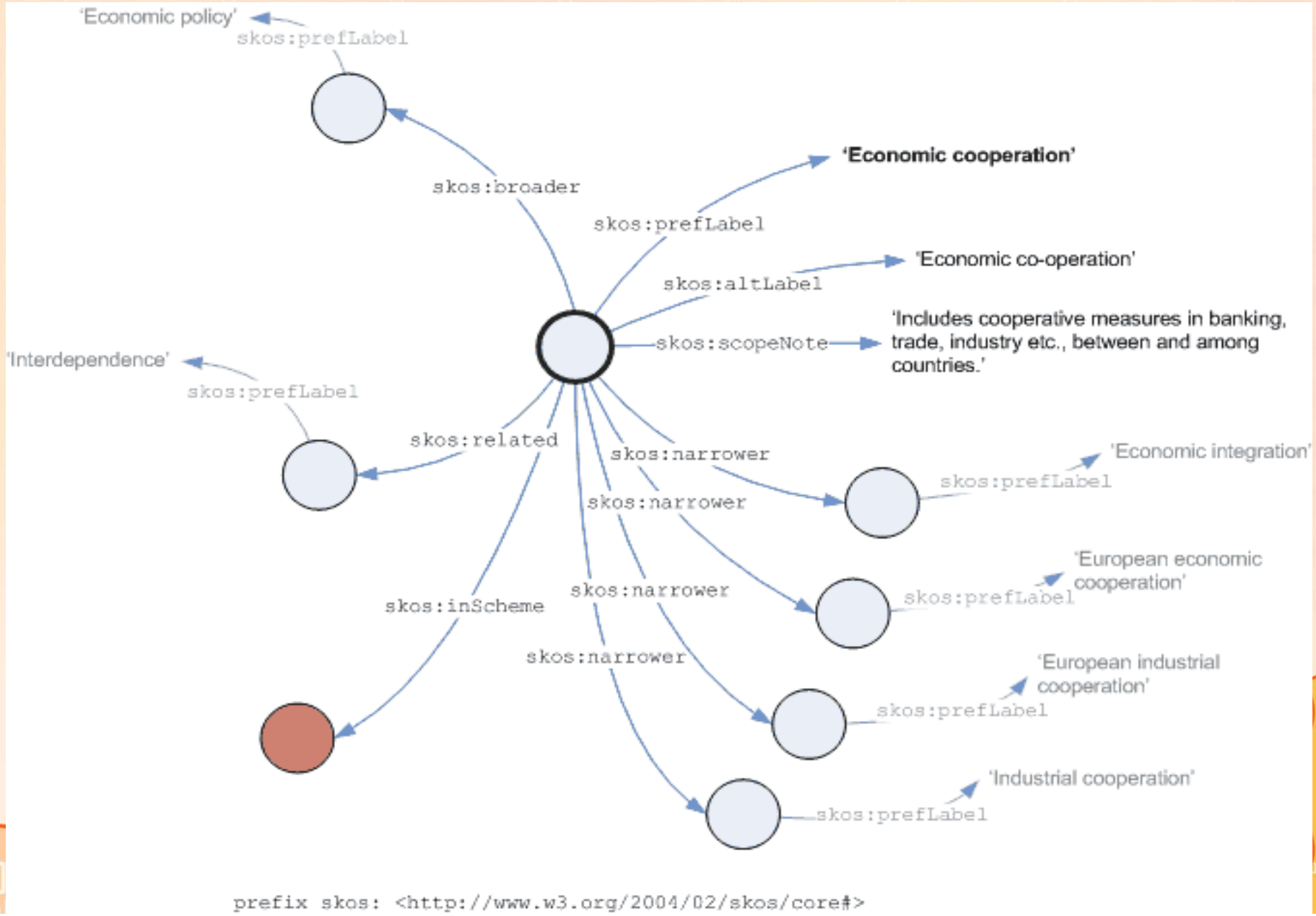
Narrower terms:
- Economic integration
- European economic cooperation
- European industrial cooperation
- Industrial cooperation

Related terms:
- Interdependence

Scope Note:
Includes cooperative measures in banking, trade, industry etc., between and among countries.

**Source: Quick Guide to Publishing a Thesaurus on the Semantic Web W3C Working Draft 17 May 2005**
http://www.w3.org/TR/2005/WD-swbp-thesaurus-pubguide-20050517

The example is expressed as an RDF graph using the SKOS Core Vocabulary http://www.w3.org/TR/2005/WD-swbp-thesaurus-pubguide-20050517/



An RDF/X

of the 'Ecc

# The thesaurus becomes machine-processable, why do we still need an ontology?

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  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
  xmlns:skos="http://www.w3.org/2004/02/skos/core#">

    <skos:Concept rdf:about="http://www.ukat.org.uk/thesaurus/concept/1750">
        <skos:prefLabel>Economic cooperation</skos:prefLabel>
        <skos:altLabel>Economic co-operation</skos:altLabel>
        <skos:scopeNote>Includes cooperative measures in banking, trade, industry etc.,
          between and among countries.</skos:scopeNote>
        <skos:broader rdf:resource="http://www.ukat.org.uk/thesaurus/concept/4382"/>
        <skos:narrower rdf:resource="http://www.ukat.org.uk/thesaurus/concept/2108"/>
        <skos:narrower rdf:resource="http://www.ukat.org.uk/thesaurus/concept/9505"/>
        <skos:narrower rdf:resource="http://www.ukat.org.uk/thesaurus/concept/15053"/>
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        <skos:inScheme rdf:resource="http://www.ukat.org.uk/thesaurus"/>
    </skos:Concept>

</rdf:RDF>
```

http://www.w3.org/TR/2005/WD-swbp-thesaurus-pubguide-20050517/

# What is an ontology?

- An ontology is an explicit specification of a conceptualization. -Gruber, T. (1993)

- An ontology defines the basic terms and relations comprising the vocabulary of a topic area, as well as the rules for combining terms and relations to define extensions to the vocabulary. -Neches, R. et al. *AI Magazine*, (Winter 1991): 36-56.

- "An ontology is a formal,
- explicit specification of
- a shared conceptualization"

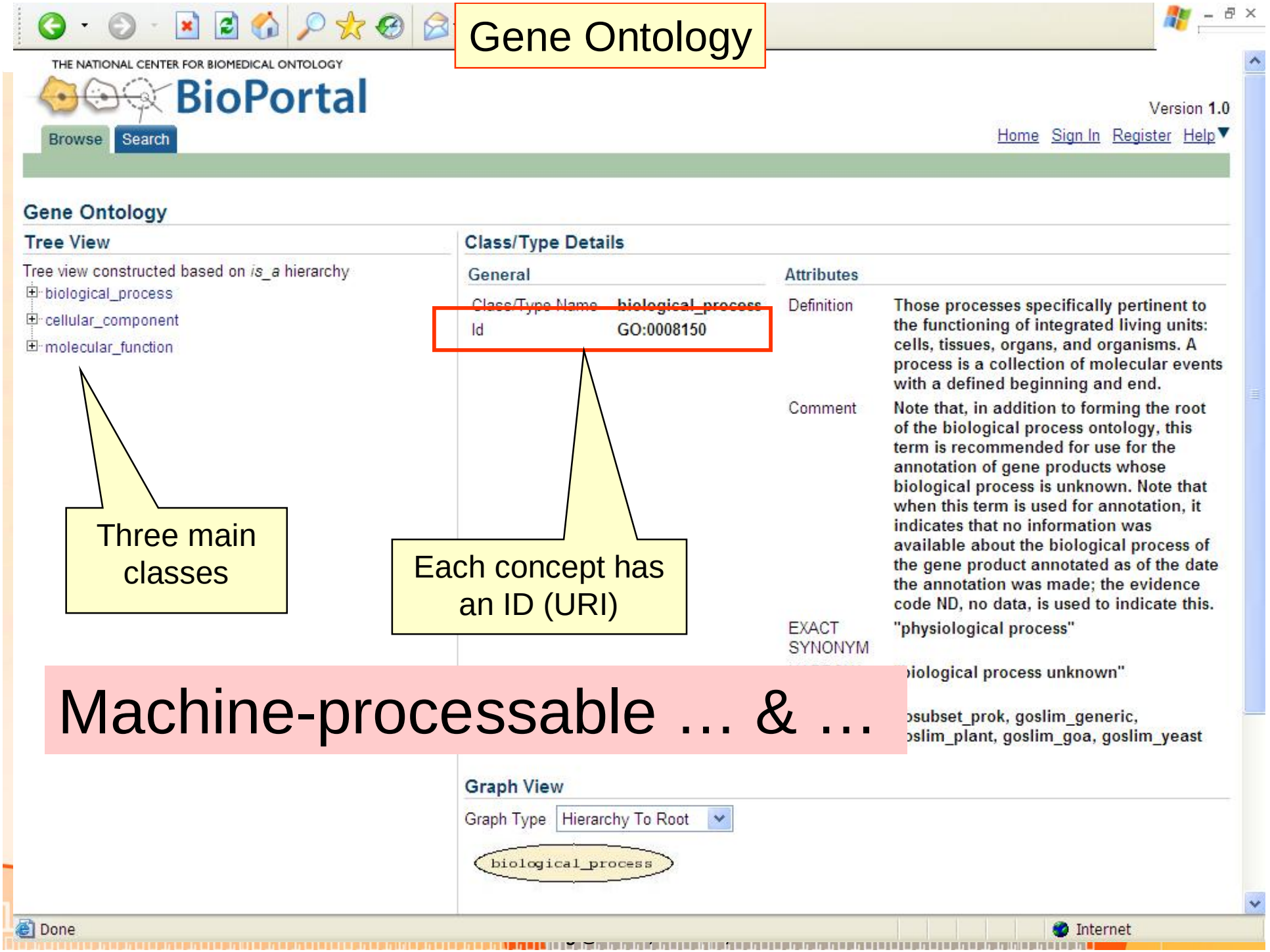
Machine-processable

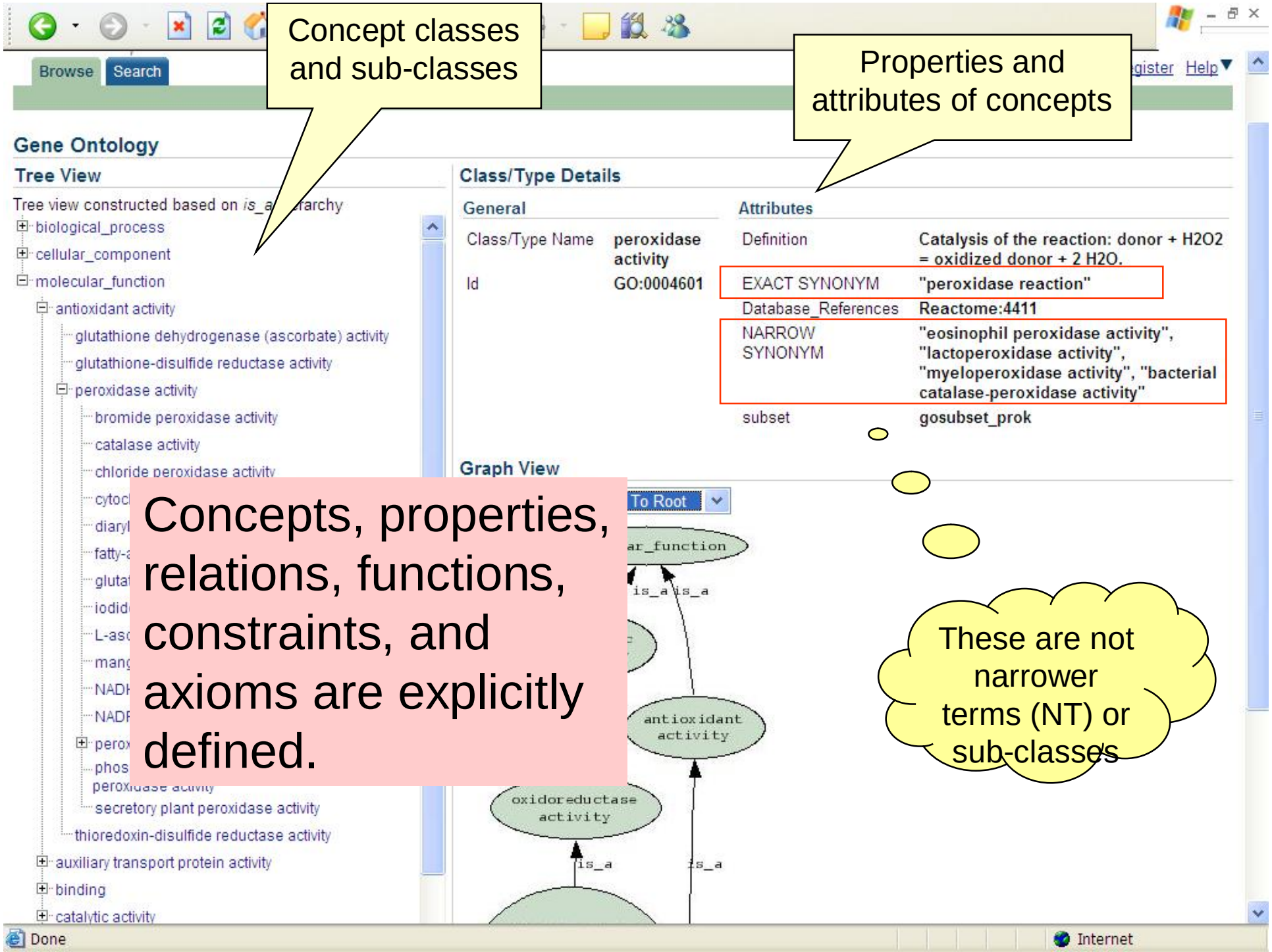
Concepts, properties relations, functions, constraints, and axioms are explicitly defined.

Consensual knowledge

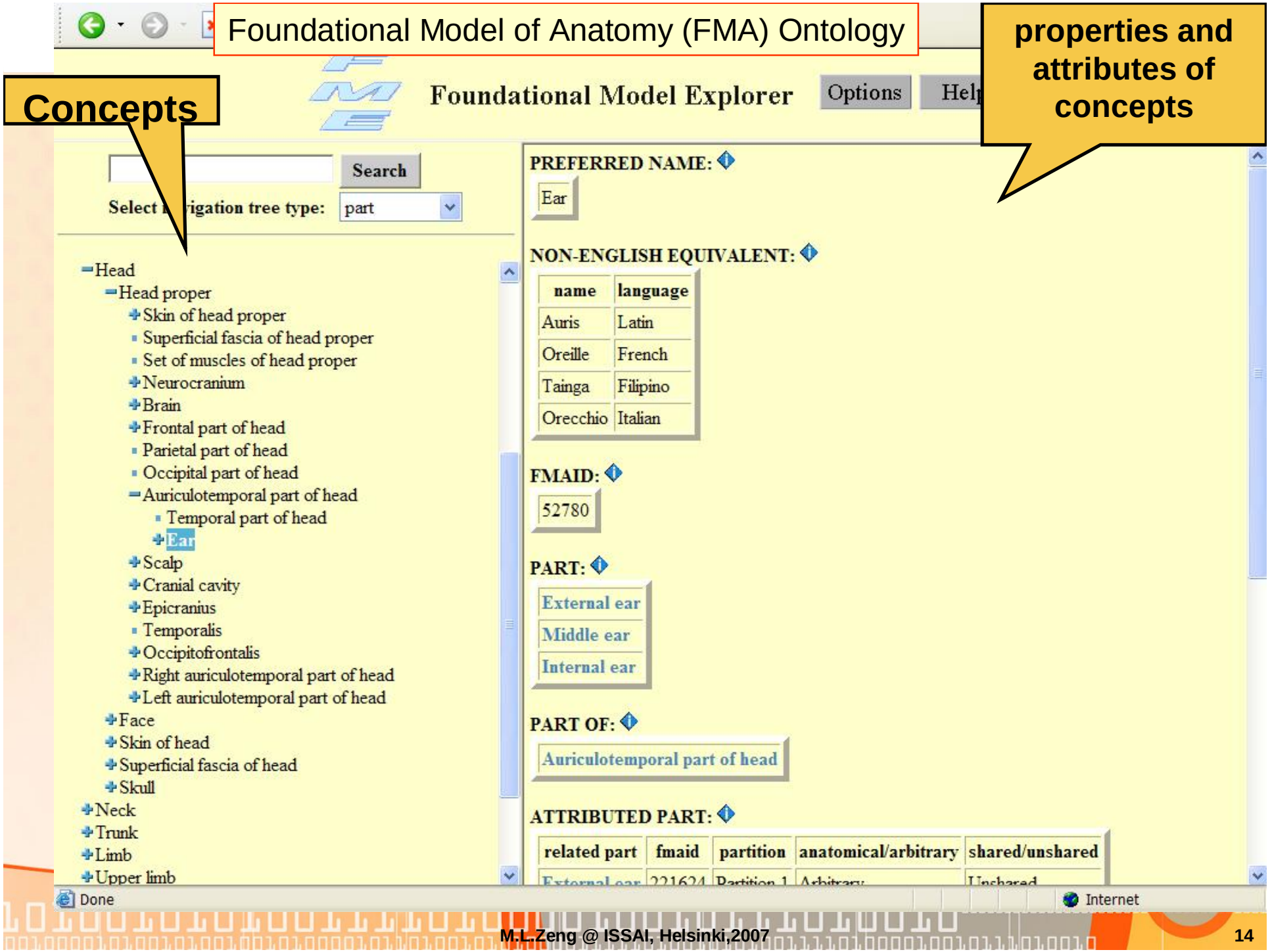
Abstract model of some phenomenon in the world

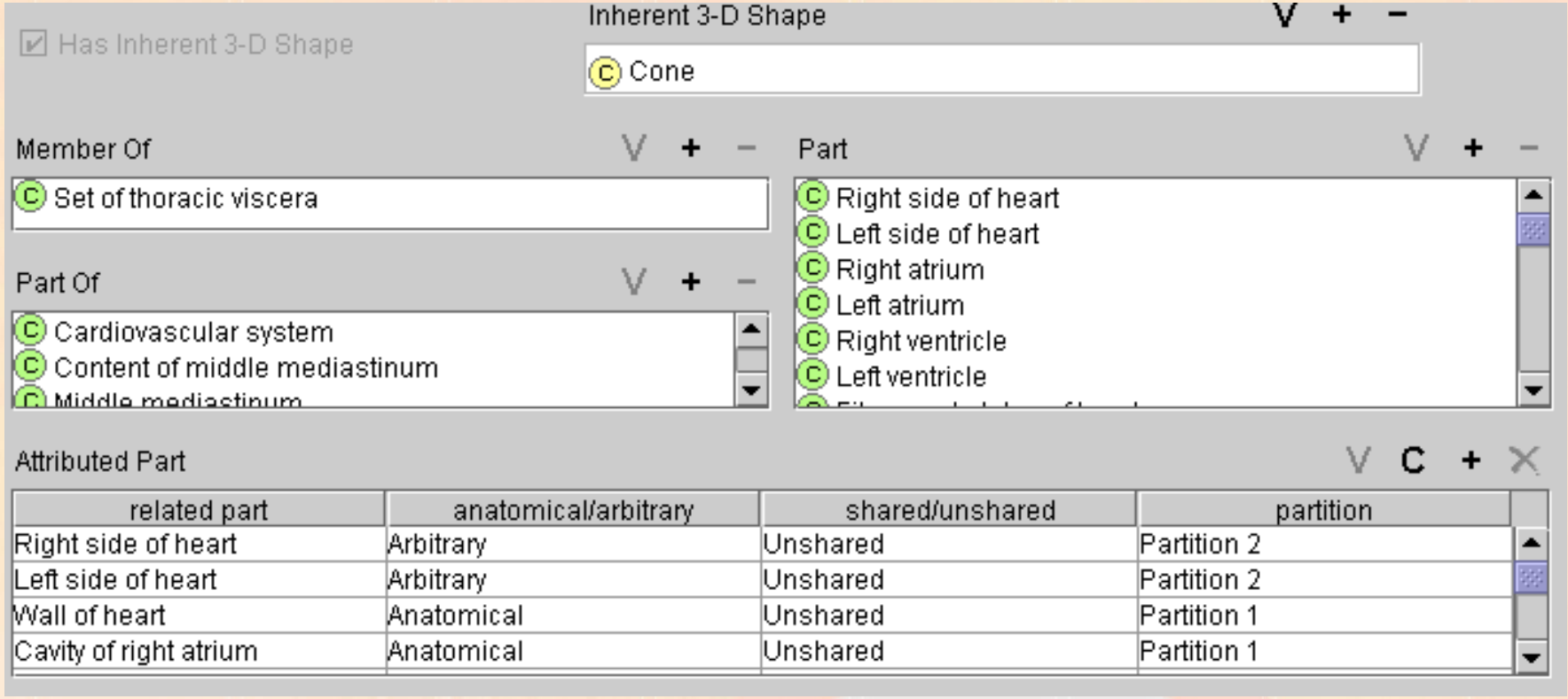
Studer, R., Benjamins, and Fensel, D. (1998). Knowledge engineering: Principles and methods, *Data and Knowledge Engineering*, 25(1998): 161-197.


Gene Ontology
THE NATIONAL CENTER FOR BIOMEDICAL ONTOLOGY
BioPortal
Version 1.0
Browse
Search
Home
Sign In
Register
Help
Gene Ontology
Tree View
Tree view constructed based on is_a hierarchy
biological_process
cellular_component
molecular_function
Class/Type Details
General
Class/Type Name
biological_process
Id
GO:0008150
Attributes
Definition
Those processes specifically pertinent to the functioning of integrated living units: cells, tissues, organs, and organisms. A process is a collection of molecular events with a defined beginning and end.
Comment
Note that, in addition to forming the root of the biological process ontology, this term is recommended for use for the annotation of gene products whose biological process is unknown. Note that when this term is used for annotation, it indicates that no information was available about the biological process of the gene product annotated as of the date the annotation was made; the evidence code ND, no data, is used to indicate this.
EXACT SYNONYM
"physiological process"
biological process unknown"
subset_prok, goslim_generic,
slim_plant, goslim_goa, goslim_yeast
Graph View
Graph Type
Hierarchy To Root
biological_process
Three main classes
Each concept has an ID (URI)
Machine-processable … & …
Done
Internet


Concept classes and sub-classes
Properties and attributes of concepts
Browse
Search
Help
Gene Ontology
Tree View
Tree view constructed based on is_a hierarchy
biological_process
cellular_component
molecular_function
antioxidant activity
glutathione dehydrogenase (ascorbate) activity
glutathione-disulfide reductase activity
peroxidase activity
bromide peroxidase activity
catalase activity
chloride peroxidase activity
secretory plant peroxidase activity
thioredoxin-disulfide reductase activity
auxiliary transport protein activity
binding
catalytic activity
Class/Type Details
General
Class/Type Name
peroxidase activity
Id
GO:0004601
Attributes
Definition
Catalysis of the reaction: donor + H2O2 = oxidized donor + 2 H2O.
EXACT SYNONYM
"peroxidase reaction"
Database_References
Reactome:4411
NARROW SYNONYM
"eosinophil peroxidase activity", "lactoperoxidase activity", "myeloperoxidase activity", "bacterial catalase-peroxidase activity"
subset
gosubset_prok
Graph View
To Root
molecular_function
is_a
is_a
antioxidant activity
oxidoreductase activity
is_a
is_a
Concepts, properties, relations, functions, constraints, and axioms are explicitly defined.
These are not narrower terms (NT) or sub-classes
Done
Internet

# Foundational Model of Anatomy (FMA) Ontology






Attributes for class *Heart* (from the classes-tab)

Source: FME 2007, http://sig.biostr.washington.edu/projects/fm/FAQs.html

# Foundational Model of Anatomy (FMA) Ontology

## FMA

### Tree View

Tree view constructed based on *hasSubclass* hierarchy

- Anatomical entity
  - Non-physical anatomical entity
  - Physical anatomical entity
    - Immaterial physical anatomical entity
    - Material anatomical entity
      - Anatomical set
      - Anatomical structure
        - Acellular anatomical structure
        - Anatomical cluster
          - Anatomical compartment
          - Body part subdivision cluster
          - Cell cluster
          - Cell part cluster
          - Compartment subdivis
          - Heterogeneous cluste
          - Organ cluster
            - Cluster of meninges
            - Erector spinae muscle group
            - Iliopsoas
            - Intertransverse muscle group
            - Lacrimal apparatus
            - Pericardium
            - Pia-arachnoid
            - Rotatores muscle group
            - Transversospinales muscle group
            - Wall of intestine
          - Organ part cluster
          - Tissue cluster

### Class/Type Details

#### General

| | |
|---|---|
| Class/Type Name | **Organ cluster** |
| Id | 32406 |

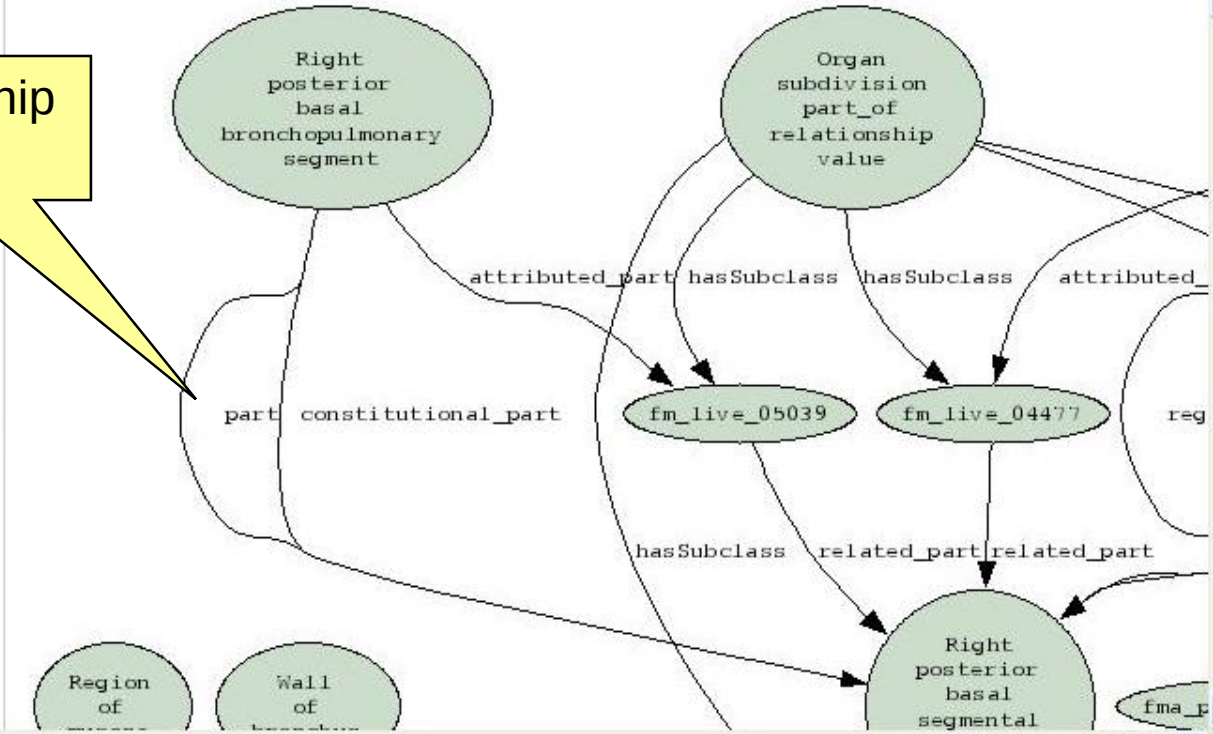
#### Attributes

| | |
|---|---|
| has_boundary | **true** |
| Definition | **Anatomical cluster which consists of al** |
| has_inherent_3-D_shape | **true** |
| dimension | **3-dimension** |
| has_dimension | **true** |
| has_mass | **true** |

### Graph View

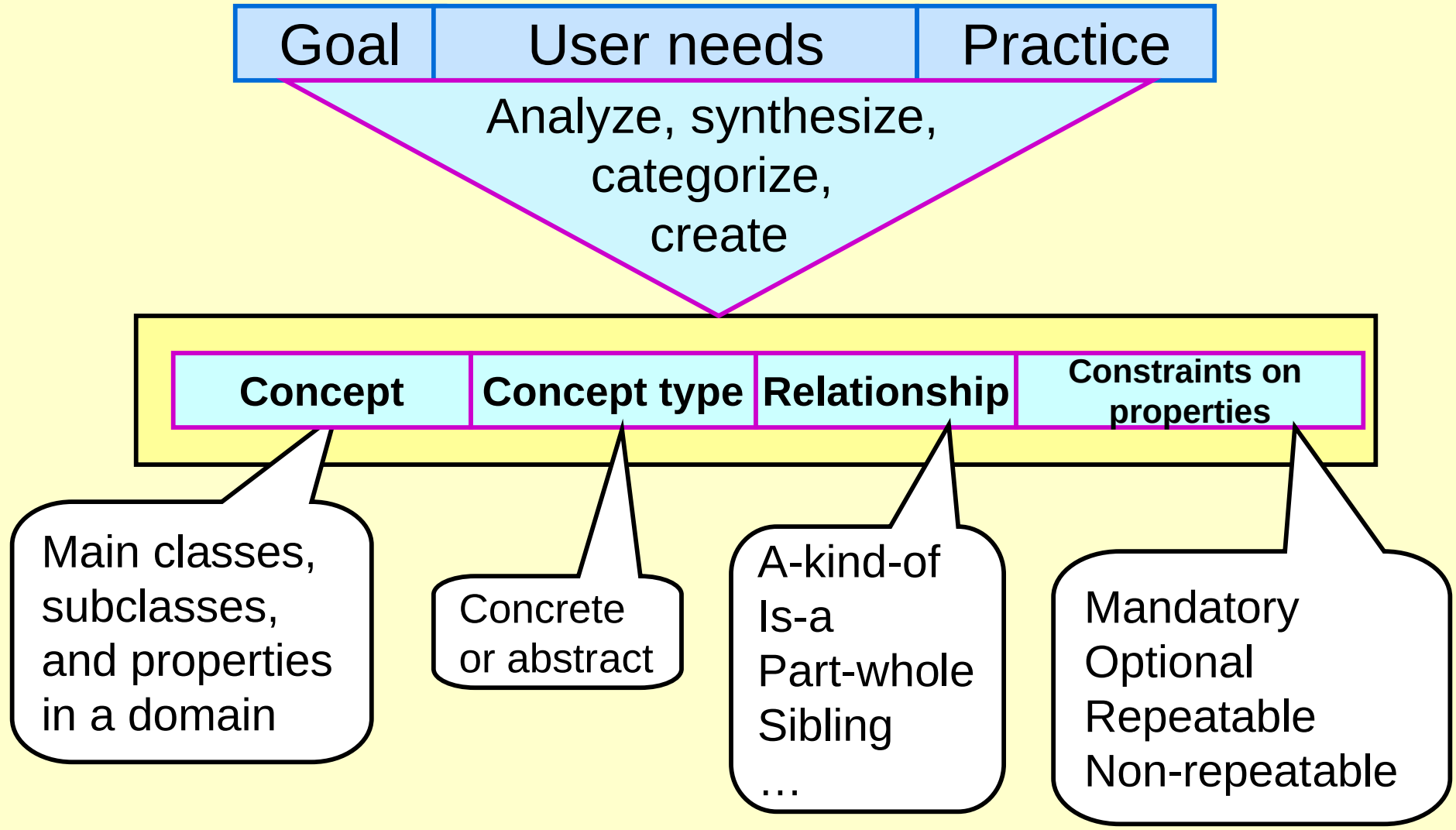
Graph Type: Hierarchy To Root (All Relationships)

Relationship types




Internet

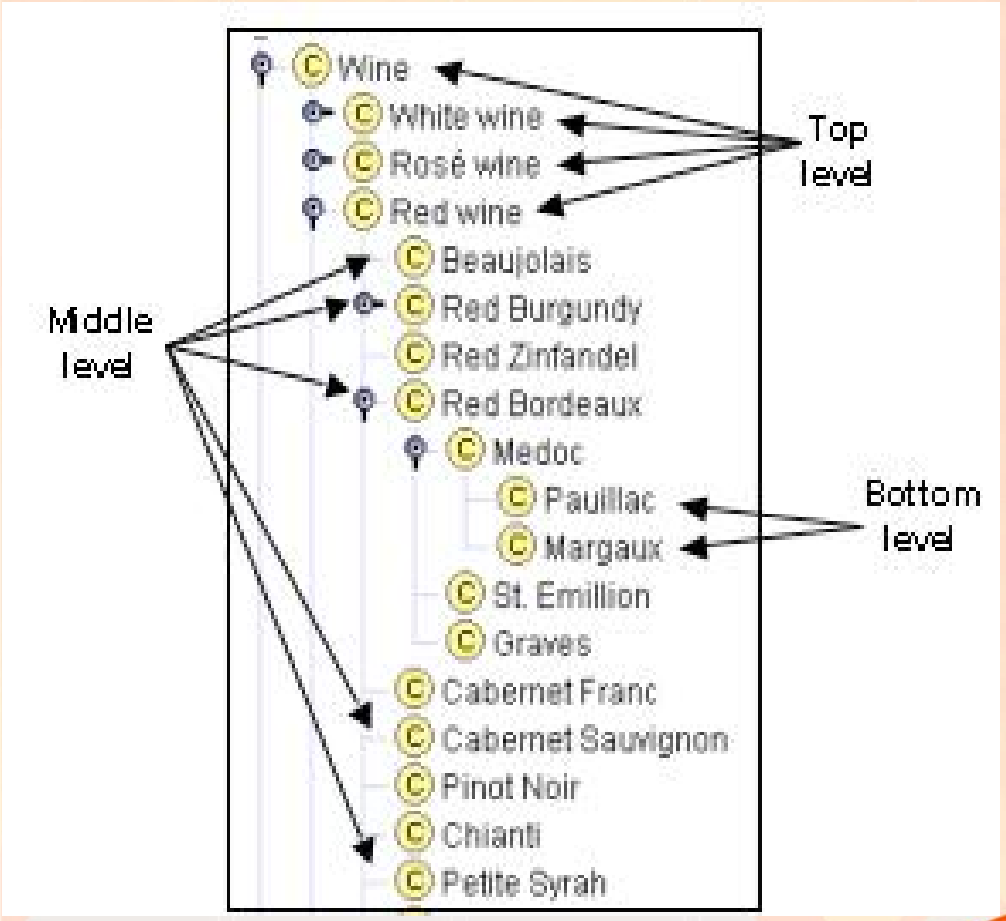
# Modeling concepts and relationships

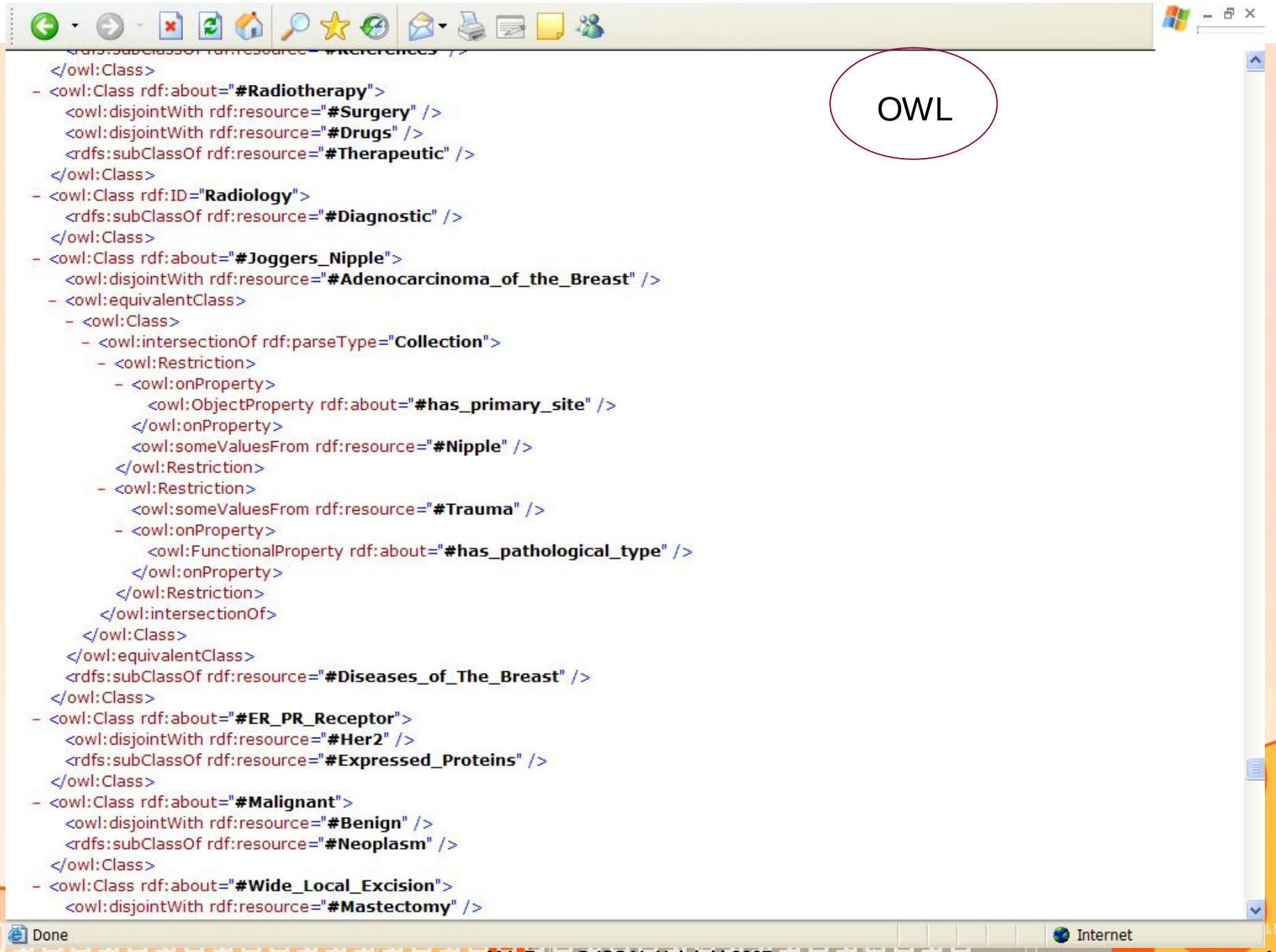



Source: Qin, 2007

# Expressed in OWL Web Ontology Language

- *Class Hierarchies*
- *Relation Hierarchies*
- *Constraints*




OWL
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<rdfs:subClassOf rdf:resource="#Therapeutic" />
</owl:Class>
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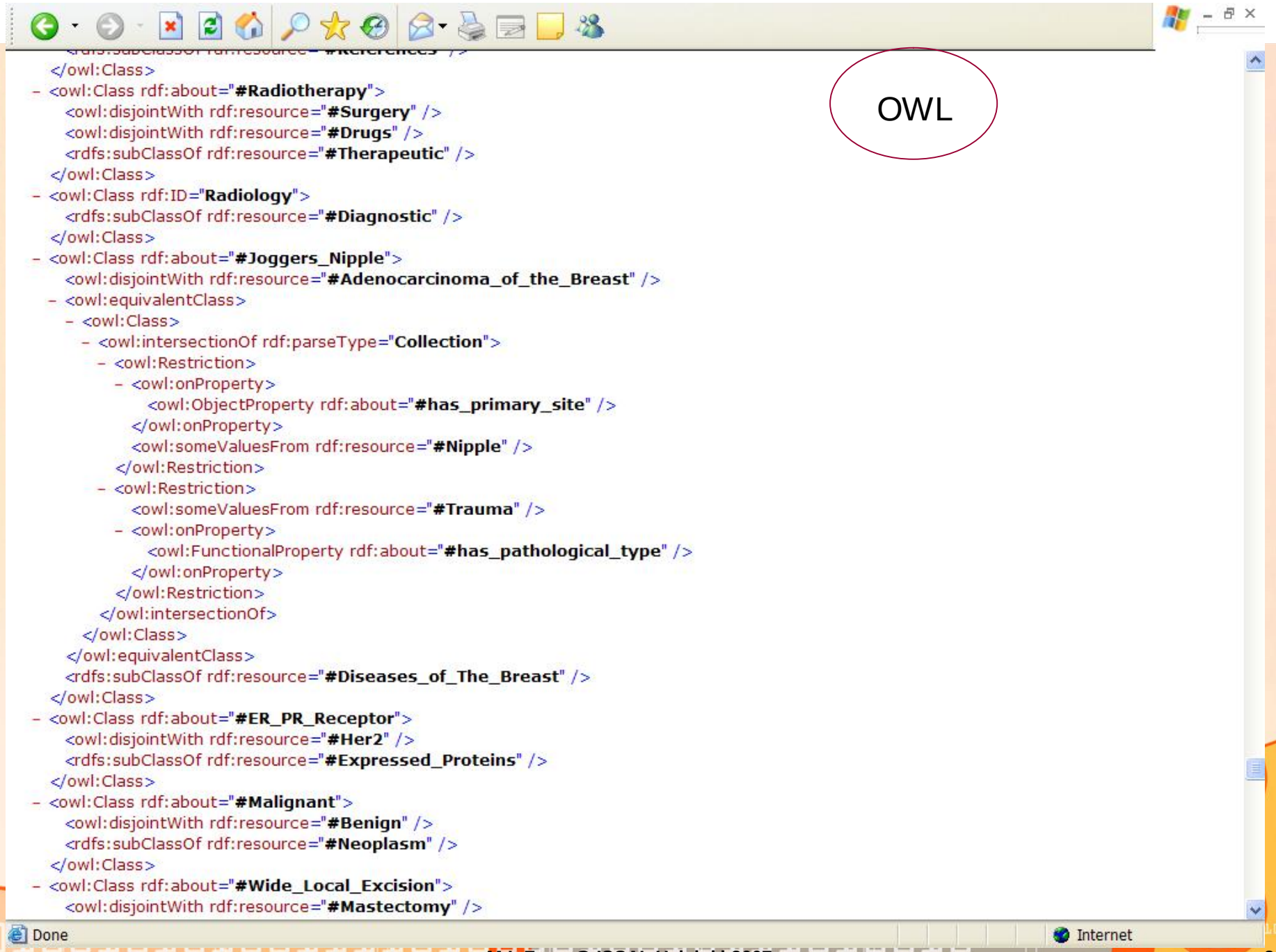
</owl:Class>
- <owl:Class rdf:about="#Joggers_Nipple">
<owl:disjointWith rdf:resource="#Adenocarcinoma_of_the_Breast" />
- <owl:equivalentClass>
- <owl:Class>
- <owl:intersectionOf rdf:parseType="Collection">
- <owl:Restriction>
- <owl:onProperty>
<owl:ObjectProperty rdf:about="#has_primary_site" />
</owl:onProperty>
<owl:someValuesFrom rdf:resource="#Nipple" />
</owl:Restriction>
- <owl:Restriction>
<owl:someValuesFrom rdf:resource="#Trauma" />
- <owl:onProperty>
<owl:FunctionalProperty rdf:about="#has_pathological_type" />
</owl:onProperty>
</owl:Restriction>
</owl:intersectionOf>
</owl:Class>
</owl:equivalentClass>
<rdfs:subClassOf rdf:resource="#Diseases_of_The_Breast" />
</owl:Class>
- <owl:Class rdf:about="#ER_PR_Receptor">
<owl:disjointWith rdf:resource="#Her2" />
<rdfs:subClassOf rdf:resource="#Expressed_Proteins" />
</owl:Class>
- <owl:Class rdf:about="#Malignant">
<owl:disjointWith rdf:resource="#Benign" />
<rdfs:subClassOf rdf:resource="#Neoplasm" />
</owl:Class>
- <owl:Class rdf:about="#Wide_Local_Excision">
<owl:disjointWith rdf:resource="#Mastectomy" />
Done
Internet

# Added to RDF by OWL (1)

- **cardinality constraints** on properties,
  - e.g., a Star is memberOf exactly one Galaxy.
- specifying constraints on the **range or cardinality** of a property depend on the class of resource,
  - e.g., for a *binarySystem* the *hasMember* property has 2 values, while for a *tripleSystem* the same property should have 3 values.
- specifying that a given property is **transitive**,
  - e.g., if A hasAncestor B, and B hasAncestor C, then A hasAncestor C.
- specifying that a given property is a **unique identifier** (or key) for instances of a particular class.

# Added to RDF by OWL (2)

- **Equivalent class**
  - specifying that two different classes (having different URIrefs) actually represent the same class.
- **Same as**
  - specifying that two different instances (having different URIrefs) actually represent the same individual.
- the ability
  - to describe new classes in terms of combinations (e.g., **unions** and **intersections**) of other classes,
  - or to say that two classes are **disjoint** (i.e., no instance belongs to both classes).


OWL
</owl:Class>
- <owl:Class rdf:about="#Radiotherapy">
<owl:disjointWith rdf:resource="#Surgery" />
<owl:disjointWith rdf:resource="#Drugs" />
<rdfs:subClassOf rdf:resource="#Therapeutic" />
</owl:Class>
- <owl:Class rdf:ID="Radiology">
<rdfs:subClassOf rdf:resource="#Diagnostic" />
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- <owl:Class rdf:about="#Joggers_Nipple">
<owl:disjointWith rdf:resource="#Adenocarcinoma_of_the_Breast" />
- <owl:equivalentClass>
- <owl:Class>
- <owl:intersectionOf rdf:parseType="Collection">
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- <owl:onProperty>
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- <owl:onProperty>
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- <owl:Class rdf:about="#Malignant">
<owl:disjointWith rdf:resource="#Benign" />
<rdfs:subClassOf rdf:resource="#Neoplasm" />
</owl:Class>
- <owl:Class rdf:about="#Wide_Local_Excision">
<owl:disjointWith rdf:resource="#Mastectomy" />
Done
Internet

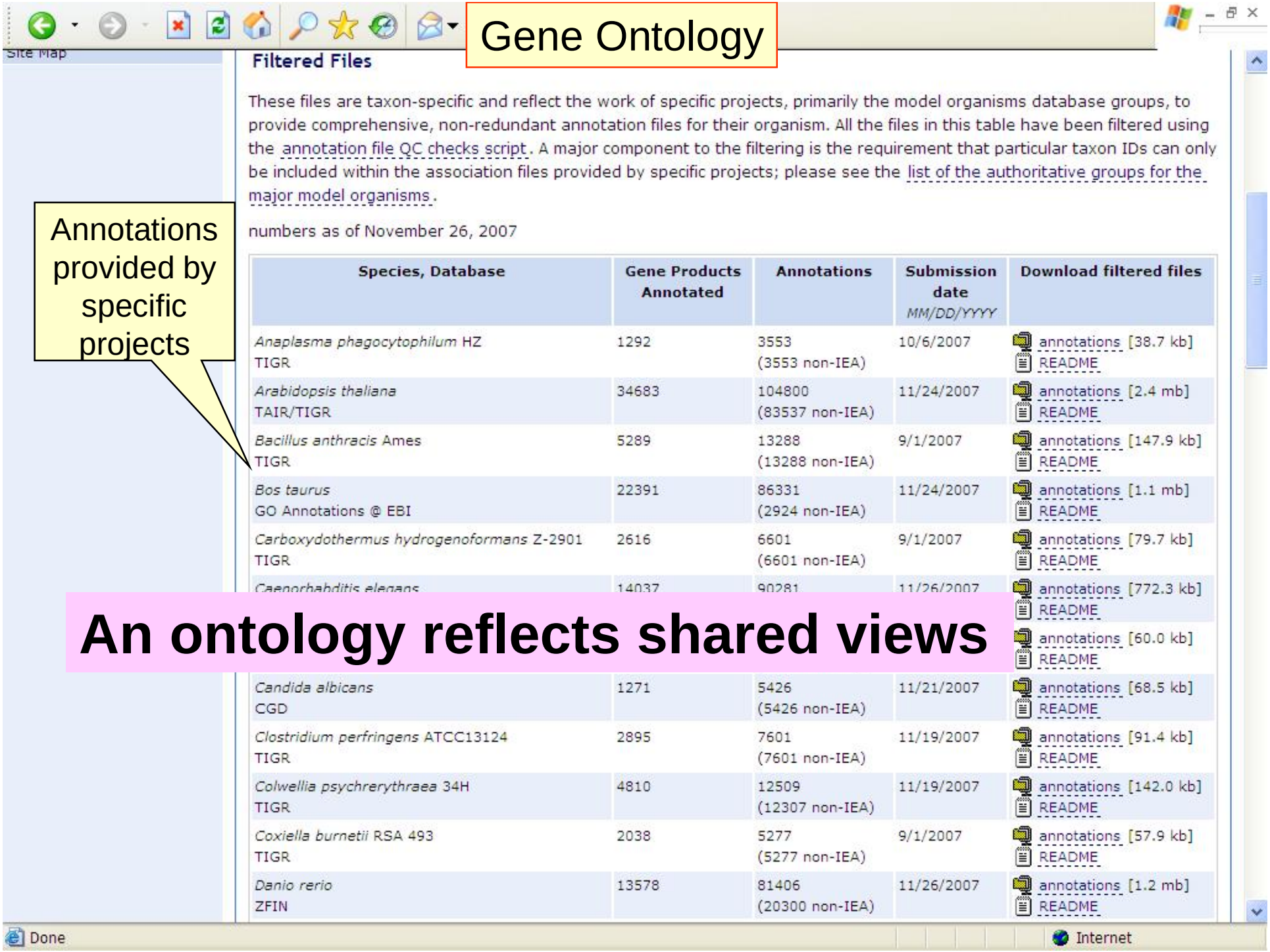
# Examples from SchemaWeb

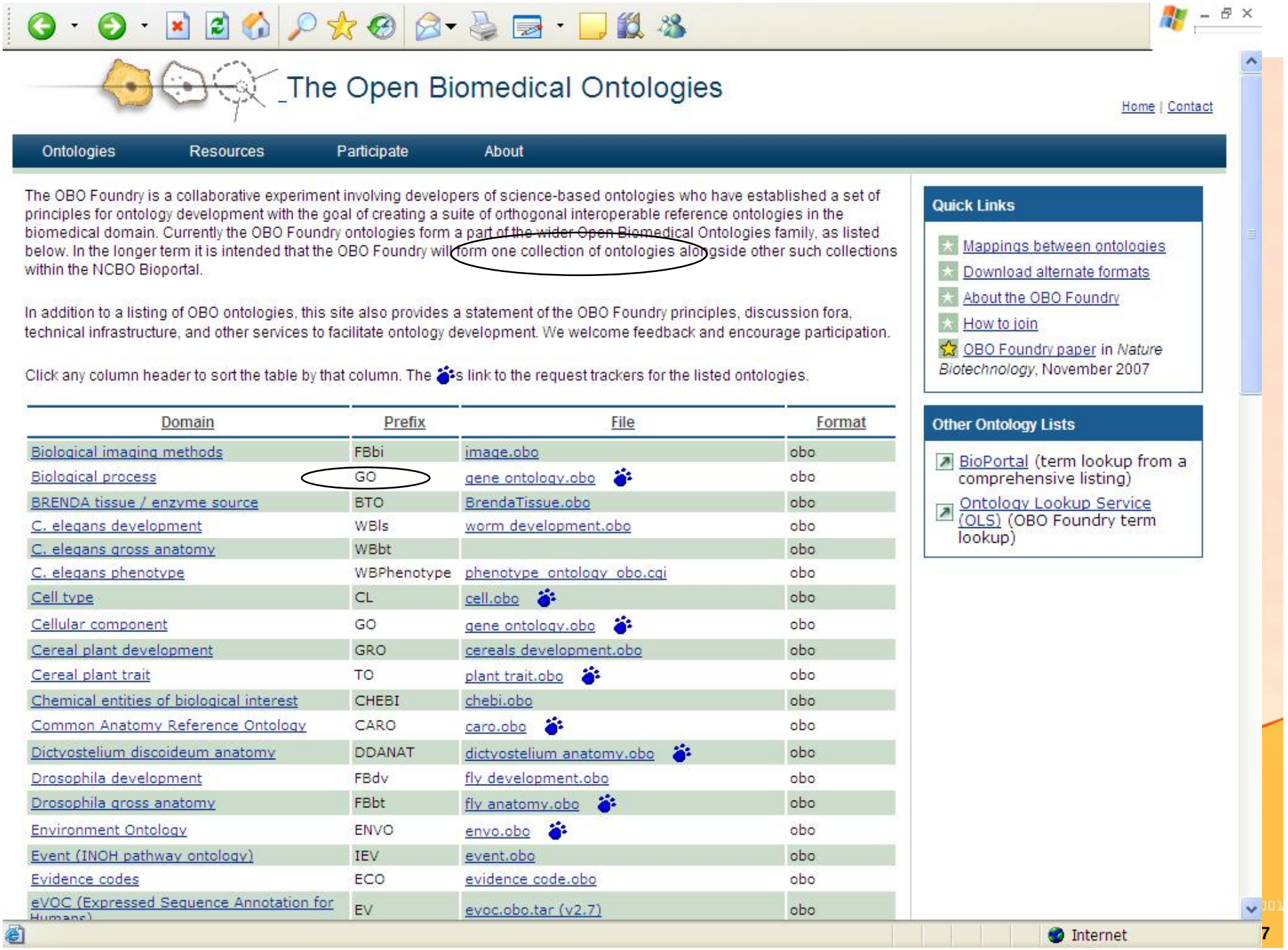
- *SchemaWeb provides a comprehensive directory of RDF schemas and OWL ontologies. http://www.schemaweb.info/default.aspx*

# Why Develop an Ontology?

- To share **common understanding** of the structure of information
  - among people
  - among software agents
- To enable **reuse** of domain knowledge
  - to avoid “re-inventing the wheel”
  - to introduce standards to allow interoperability

- An ontology is an explicit description of a domain:
  - concepts
  - properties and attributes of concepts
  - constraints on properties and attributes
  - Individuals *(often, but not always)*
- An ontology defines
  - **a common vocabulary**
  - **a shared understanding**


Gene Ontology
Site Map
Filtered Files
These files are taxon-specific and reflect the work of specific projects, primarily the model organisms database groups, to provide comprehensive, non-redundant annotation files for their organism. All the files in this table have been filtered using the annotation file QC checks script. A major component to the filtering is the requirement that particular taxon IDs can only be included within the association files provided by specific projects; please see the list of the authoritative groups for the major model organisms.
numbers as of November 26, 2007
Annotations provided by specific projects
Species, Database
Gene Products Annotated
Annotations
Submission date MM/DD/YYYY
Download filtered files
Anaplasma phagocytophilum HZ TIGR 1292 3553 (3553 non-IEA) 10/6/2007 annotations [38.7 kb] README
Arabidopsis thaliana TAIR/TIGR 34683 104800 (83537 non-IEA) 11/24/2007 annotations [2.4 mb] README
Bacillus anthracis Ames TIGR 5289 13288 (13288 non-IEA) 9/1/2007 annotations [147.9 kb] README
Bos taurus GO Annotations @ EBI 22391 86331 (2924 non-IEA) 11/24/2007 annotations [1.1 mb] README
Carboxydothermus hydrogenoformans Z-2901 TIGR 2616 6601 (6601 non-IEA) 9/1/2007 annotations [79.7 kb] README
Caenorhabditis elegans 14037 90281 11/26/2007 annotations [772.3 kb] README
annotations [60.0 kb] README
An ontology reflects shared views
Candida albicans CGD 1271 5426 (5426 non-IEA) 11/21/2007 annotations [68.5 kb] README
Clostridium perfringens ATCC13124 TIGR 2895 7601 (7601 non-IEA) 11/19/2007 annotations [91.4 kb] README
Colwellia psychrerythraea 34H TIGR 4810 12509 (12307 non-IEA) 11/19/2007 annotations [142.0 kb] README
Coxiella burnetii RSA 493 TIGR 2038 5277 (5277 non-IEA) 9/1/2007 annotations [57.9 kb] README
Danio rerio ZFIN 13578 81406 (20300 non-IEA) 11/26/2007 annotations [1.2 mb] README
Done
Internet



# The Open Biomedical Ontologies

Home | Contact

Ontologies | Resources | Participate | About

The OBO Foundry is a collaborative experiment involving developers of science-based ontologies who have established a set of principles for ontology development with the goal of creating a suite of orthogonal interoperable reference ontologies in the biomedical domain. Currently the OBO Foundry ontologies form a part of the wider Open Biomedical Ontologies family, as listed below. In the longer term it is intended that the OBO Foundry will form one collection of ontologies alongside other such collections within the NCBO Bioportal.

In addition to a listing of OBO ontologies, this site also provides a statement of the OBO Foundry principles, discussion fora, technical infrastructure, and other services to facilitate ontology development. We welcome feedback and encourage participation.

Click any column header to sort the table by that column. The 🐾s link to the request trackers for the listed ontologies.

| Domain | Prefix | File | Format |
|---|---|---|---|
| Biological imaging methods | FBbi | image.obo | obo |
| Biological process | GO | gene ontology.obo 🐾 | obo |
| BRENDA tissue / enzyme source | BTO | BrendaTissue.obo | obo |
| C. elegans development | WBls | worm development.obo | obo |
| C. elegans gross anatomy | WBbt | | obo |
| C. elegans phenotype | WBPhenotype | phenotype_ontology_obo.cgi | obo |
| Cell type | CL | cell.obo 🐾 | obo |
| Cellular component | GO | gene ontology.obo 🐾 | obo |
| Cereal plant development | GRO | cereals development.obo | obo |
| Cereal plant trait | TO | plant trait.obo 🐾 | obo |
| Chemical entities of biological interest | CHEBI | chebi.obo | obo |
| Common Anatomy Reference Ontology | CARO | caro.obo 🐾 | obo |
| Dictyostelium discoideum anatomy | DDANAT | dictyostelium anatomy.obo 🐾 | obo |
| Drosophila development | FBdv | fly development.obo | obo |
| Drosophila gross anatomy | FBbt | fly anatomy.obo 🐾 | obo |
| Environment Ontology | ENVO | envo.obo 🐾 | obo |
| Event (INOH pathway ontology) | IEV | event.obo | obo |
| Evidence codes | ECO | evidence code.obo | obo |
| eVOC (Expressed Sequence Annotation for Humans) | EV | evoc.obo.tar (v2.7) | obo |

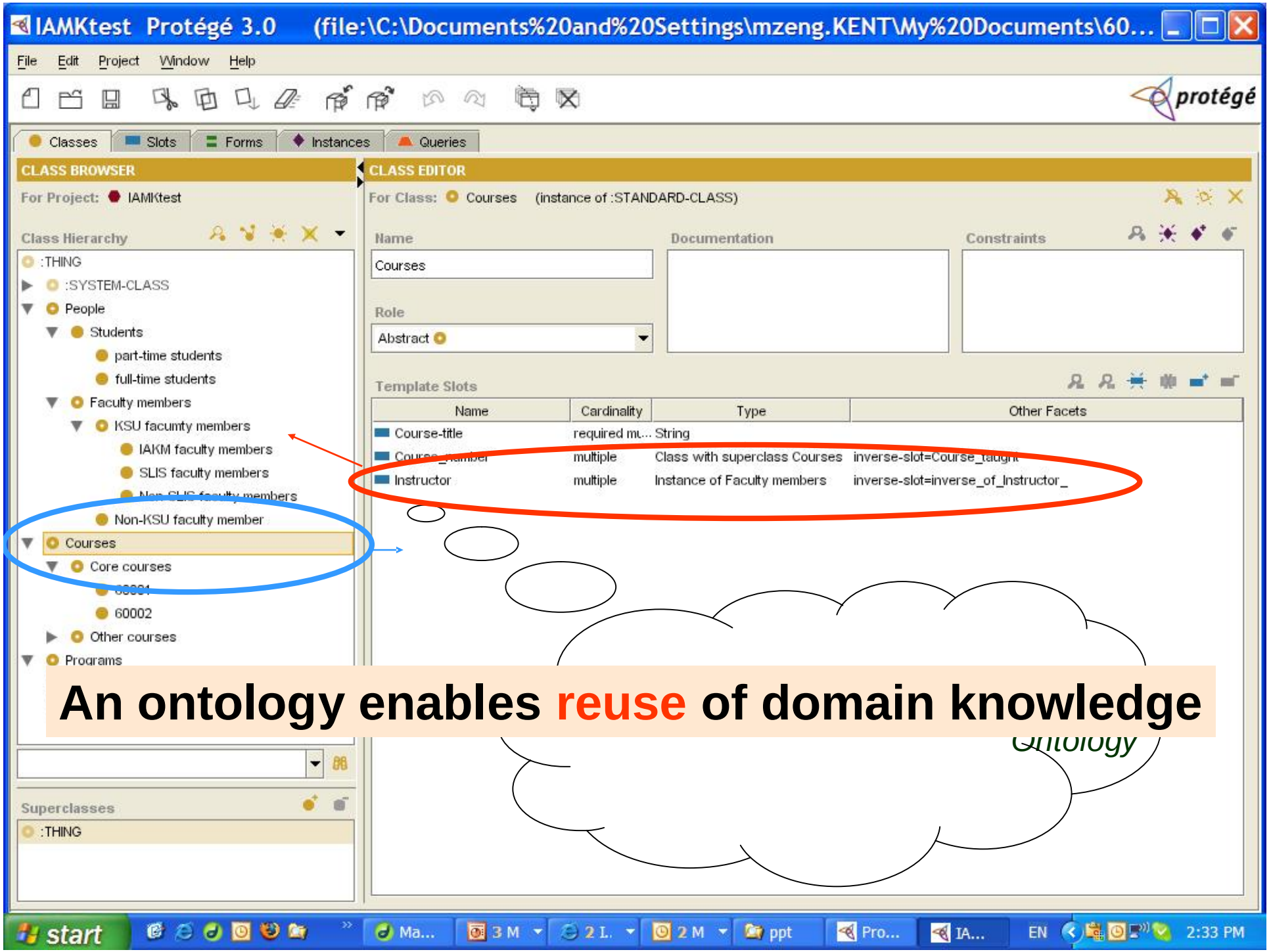
**Quick Links**

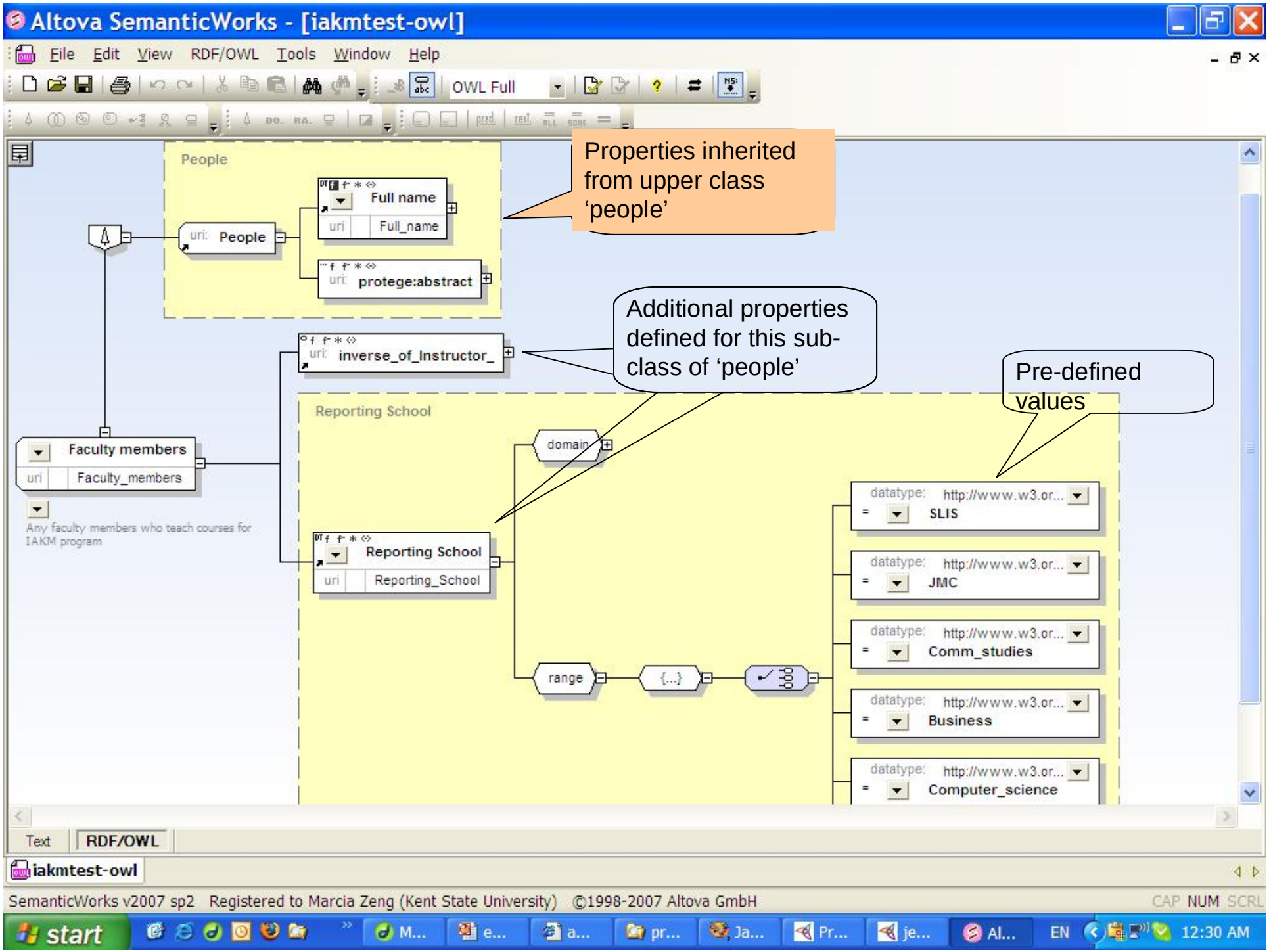
- Mappings between ontologies
- Download alternate formats
- About the OBO Foundry
- How to join
- OBO Foundry paper in *Nature Biotechnology*, November 2007

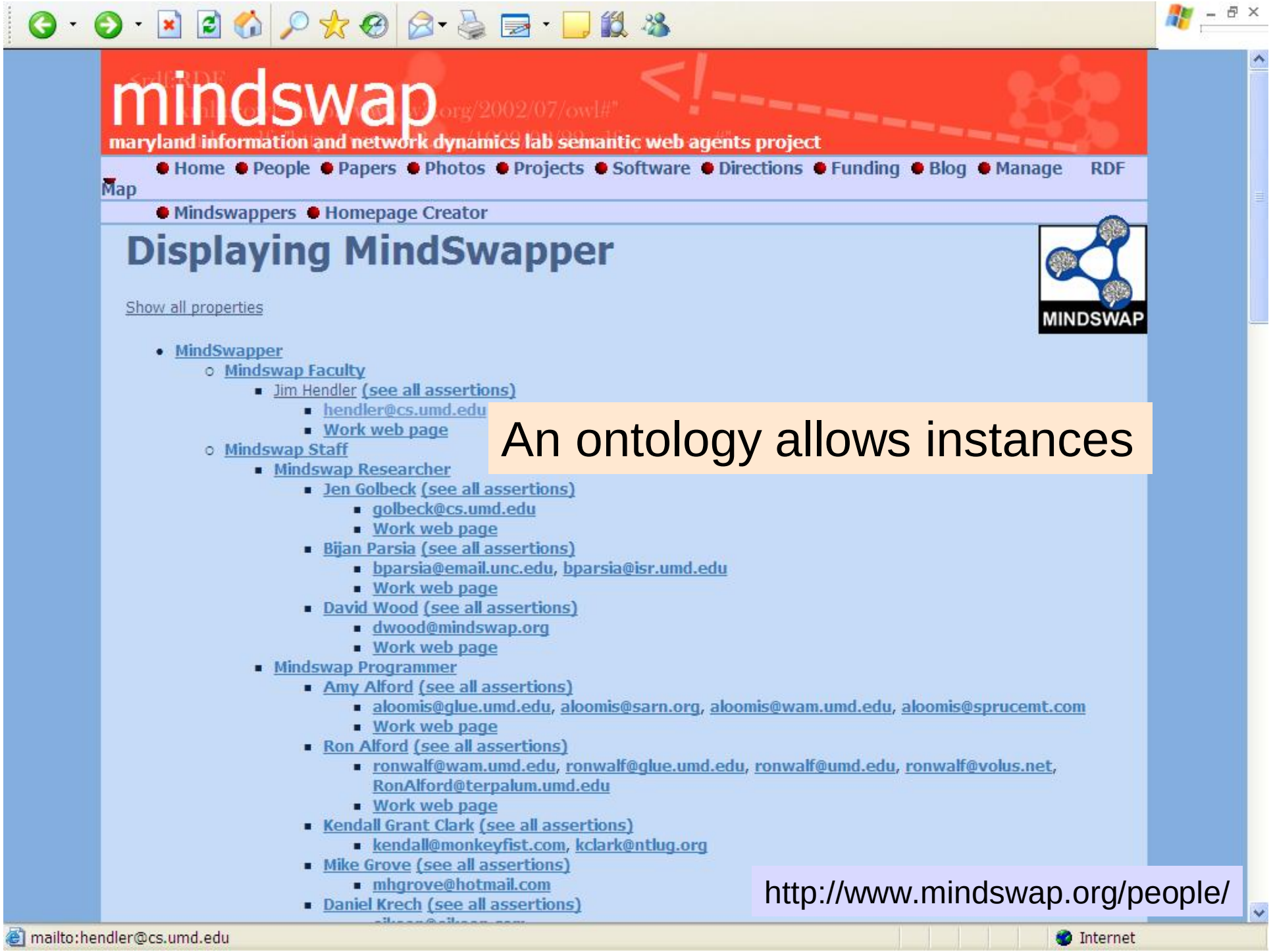
**Other Ontology Lists**

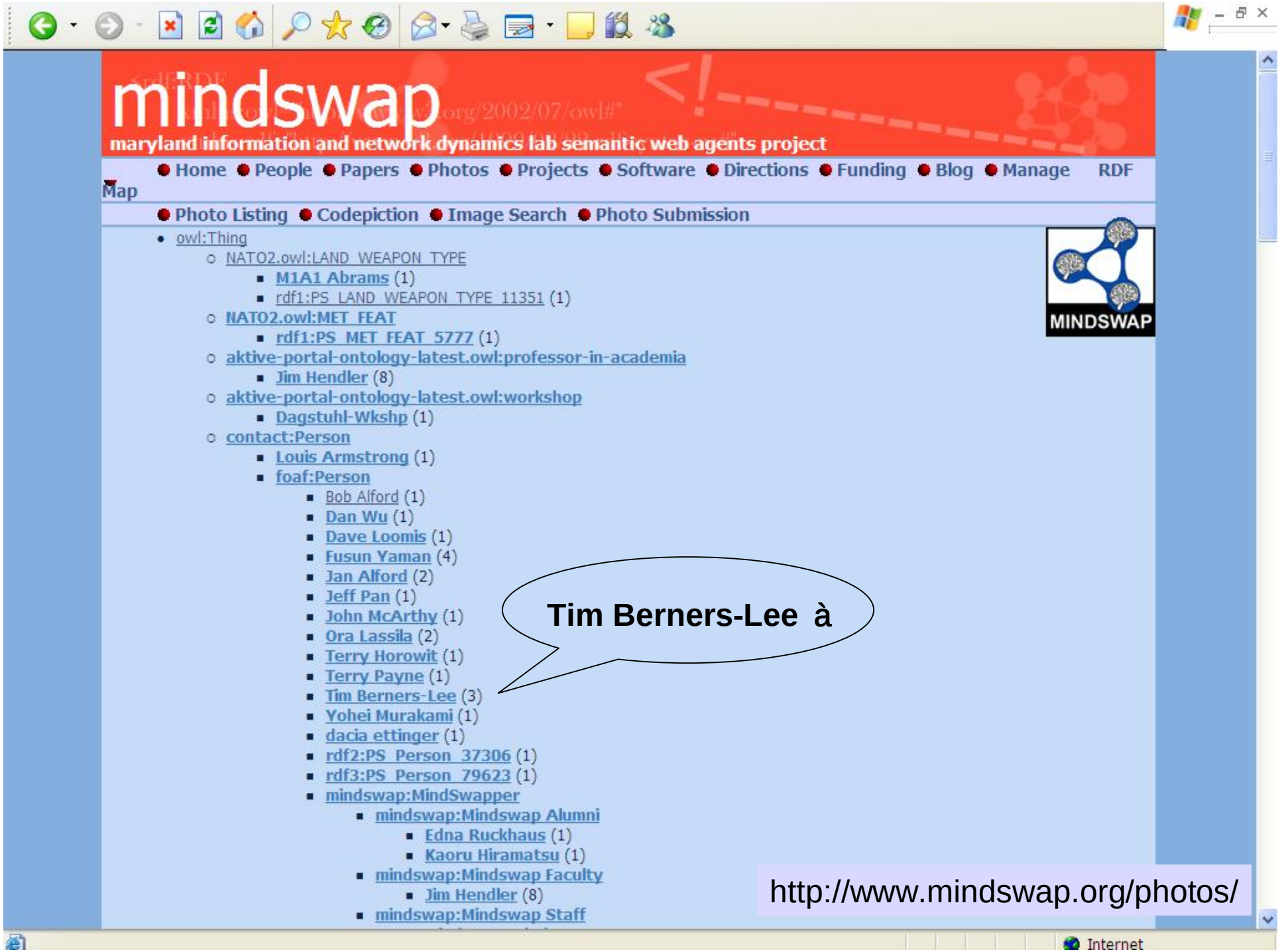
- BioPortal (term lookup from a comprehensive listing)
- Ontology Lookup Service (OLS) (OBO Foundry term lookup)

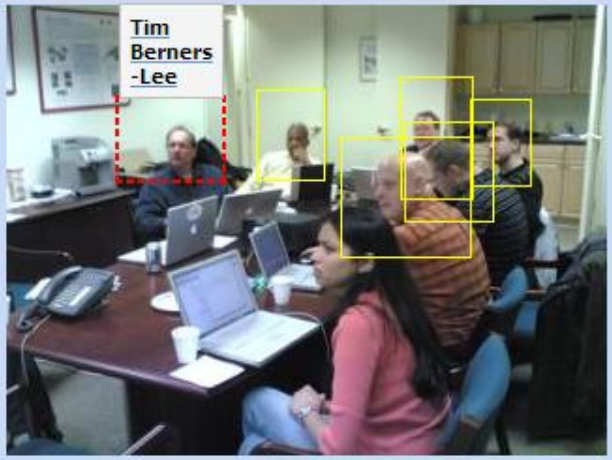
Internet


IAMKtest Protégé 3.0 (file:\C:\Documents%20and%20Settings\mzeng.KENT\My%20Documents\60...
File Edit Project Window Help
protégé
Classes Slots Forms Instances Queries
CLASS BROWSER
For Project: IAMKtest
Class Hierarchy
:THING
:SYSTEM-CLASS
People
Students
part-time students
full-time students
Faculty members
KSU facumty members
IAKM faculty members
SLIS faculty members
Non-KSU faculty member
Courses
Core courses
60002
Other courses
Programs
Superclasses
:THING
CLASS EDITOR
For Class: Courses (instance of :STANDARD-CLASS)
Name
Courses
Documentation
Constraints
Role
Abstract
Template Slots
Name
Cardinality
Type
Other Facets
Course-title
required m...
String
multiple
Class with superclass Courses
inverse-slot=Course_taught
Instructor
multiple
Instance of Faculty members
inverse-slot=inverse_of_Instructor_
Ontology
An ontology enables reuse of domain knowledge
start
2:33 PM


Altova SemanticWorks - [iakmtest-owl]
File Edit View RDF/OWL Tools Window Help
OWL Full
People
Full name
uri Full_name
uri: People
uri: protege:abstract
Properties inherited from upper class 'people'
uri: inverse_of_Instructor_
Additional properties defined for this sub-class of 'people'
Pre-defined values
Reporting School
domain
Faculty members
uri Faculty_members
Any faculty members who teach courses for IAKM program
Reporting School
uri Reporting_School
range
{...}
datatype: http://www.w3.or... = SLIS
datatype: http://www.w3.or... = JMC
datatype: http://www.w3.or... = Comm_studies
datatype: http://www.w3.or... = Business
datatype: http://www.w3.or... = Computer_science
Text RDF/OWL
iakmtest-owl
SemanticWorks v2007 sp2 Registered to Marcia Zeng (Kent State University) ©1998-2007 Altova GmbH
CAP NUM SCRL
start
EN 12:30 AM


mindswap
maryland information and network dynamics lab semantic web agents project
Home People Papers Photos Projects Software Directions Funding Blog Manage RDF Map
Mindswappers Homepage Creator
Displaying MindSwapper
Show all properties
MINDSWAP
MindSwapper
Mindswap Faculty
Jim Hendler (see all assertions)
hendler@cs.umd.edu
Work web page
Mindswap Staff
Mindswap Researcher
Jen Golbeck (see all assertions)
golbeck@cs.umd.edu
Work web page
Bijan Parsia (see all assertions)
bparsia@email.unc.edu, bparsia@isr.umd.edu
Work web page
David Wood (see all assertions)
dwood@mindswap.org
Work web page
Mindswap Programmer
Amy Alford (see all assertions)
aloomis@glue.umd.edu, aloomis@sarn.org, aloomis@wam.umd.edu, aloomis@sprucemt.com
Work web page
Ron Alford (see all assertions)
ronwalf@wam.umd.edu, ronwalf@glue.umd.edu, ronwalf@umd.edu, ronwalf@volus.net, RonAlford@terpalum.umd.edu
Work web page
Kendall Grant Clark (see all assertions)
kendall@monkeyfist.com, kclark@ntlug.org
Mike Grove (see all assertions)
mhgrove@hotmail.com
Daniel Krech (see all assertions)
An ontology allows instances
http://www.mindswap.org/people/
mailto:hendler@cs.umd.edu
Internet


mindswap
maryland information and network dynamics lab semantic web agents project
Home People Papers Photos Projects Software Directions Funding Blog Manage RDF Map
Photo Listing Codepiction Image Search Photo Submission
MINDSWAP
owl:Thing
NATO2.owl:LAND_WEAPON_TYPE
M1A1 Abrams (1)
rdf1:PS_LAND_WEAPON_TYPE_11351 (1)
NATO2.owl:MET_FEAT
rdf1:PS_MET_FEAT_5777 (1)
aktive-portal-ontology-latest.owl:professor-in-academia
Jim Hendler (8)
aktive-portal-ontology-latest.owl:workshop
Dagstuhl-Wkshp (1)
contact:Person
Louis Armstrong (1)
foaf:Person
Bob Alford (1)
Dan Wu (1)
Dave Loomis (1)
Fusun Yaman (4)
Jan Alford (2)
Jeff Pan (1)
John McArthy (1)
Ora Lassila (2)
Terry Horowit (1)
Terry Payne (1)
Tim Berners-Lee (3)
Yohei Murakami (1)
dacia ettinger (1)
rdf2:PS_Person_37306 (1)
rdf3:PS_Person_79623 (1)
mindswap:MindSwapper
mindswap:Mindswap Alumni
Edna Ruckhaus (1)
Kaoru Hiramatsu (1)
mindswap:Mindswap Faculty
Jim Hendler (8)
mindswap:Mindswap Staff
Tim Berners-Lee à
http://www.mindswap.org/photos/
Internet




**Tim Berners-Lee as an instance of person**

| | | |
|---|---|---|
| Tim Berners-Lee | type | Agent, Keynote Speaker, Thing, Person |
| | made | http://dig.csail.mit.edu/2006/Papers/TPLP/n3logic-tplp.pdf, http://www.mindswap.org/users/hendler/2004/PAW.html, http://www.sciam.com/article.cfm?articleID=00048144-10D2-1C70-84A9809EC588EF21 |
| | sameAs | Tim Berners-Lee |
| | personal mailbox | mailto:timbl@w3.org |
| | depiction | region5022, http://www.mindswap.org/dav/images/timbl.png, http://owl.mindswap.org/2003/submit-rdf/417.rdf#regiontblRegion |
| | http://www.mindswap.org/~golbeck/web/www04photo.owl#presenterOf | http://owl.mindswap.org/2003/submit-rdf/417.rdf#WWW 2003 Keynote talk |

| | | |
|---|---|---|
| http://www.mindswap.org/users/hendler/2004/PAW.html, http://dig.csail.mit.edu/2006/Papers/TPLP/n3logic-tplp.pdf, http://www.sciam.com/article.cfm?articleID=00048144-10D2-1C70-84A9809EC588EF21 | maker | Tim Berners-Lee |
| Tim Berners-Lee | sameAs | |
| http://owl.mindswap.org/2003/submit-rdf/417.rdf#regiontblRegion, http://www.mindswap.org/dav/images/timbl.png, region5022 | depicts | |

region5022 - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites

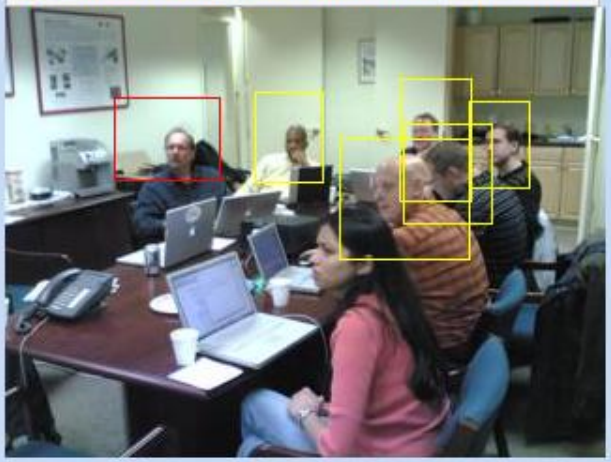
Address http://www.mindswap.org/rdf/instance/?inst=http%3A%2F%2Fowl.mindswap.org%2F2003%2Fsubmit-rdf%2F905.rdf%23A2

Google OWL ontology I Go Bookmarks 485 blocked Check AutoLink AutoFill Send to Settings

Map

Search Instances

http://www.mindswap.org/dav/images/01182006.jpg



Tim Berners-Lee's picture as an image region in this picture instance

MINDSWAP

| | | |
|---|---|---|
| region5022 | type | http://www.w3.org/2004/02/image-regions#Rectangle, Image Part |
| | regionOf | http://www.mindswap.org/dav/images/01182006.jpg |
| | depicts | Tim Berners-Lee |
| | http://www.w3.org/2004/02/image-regions#coords | 232,194 454,366 |

| | | |
|---|---|---|
| http://www.mindswap.org/dav/images/01182006.jpg | hasRegion | region5022 |
| Tim Berners-Lee | depiction | |

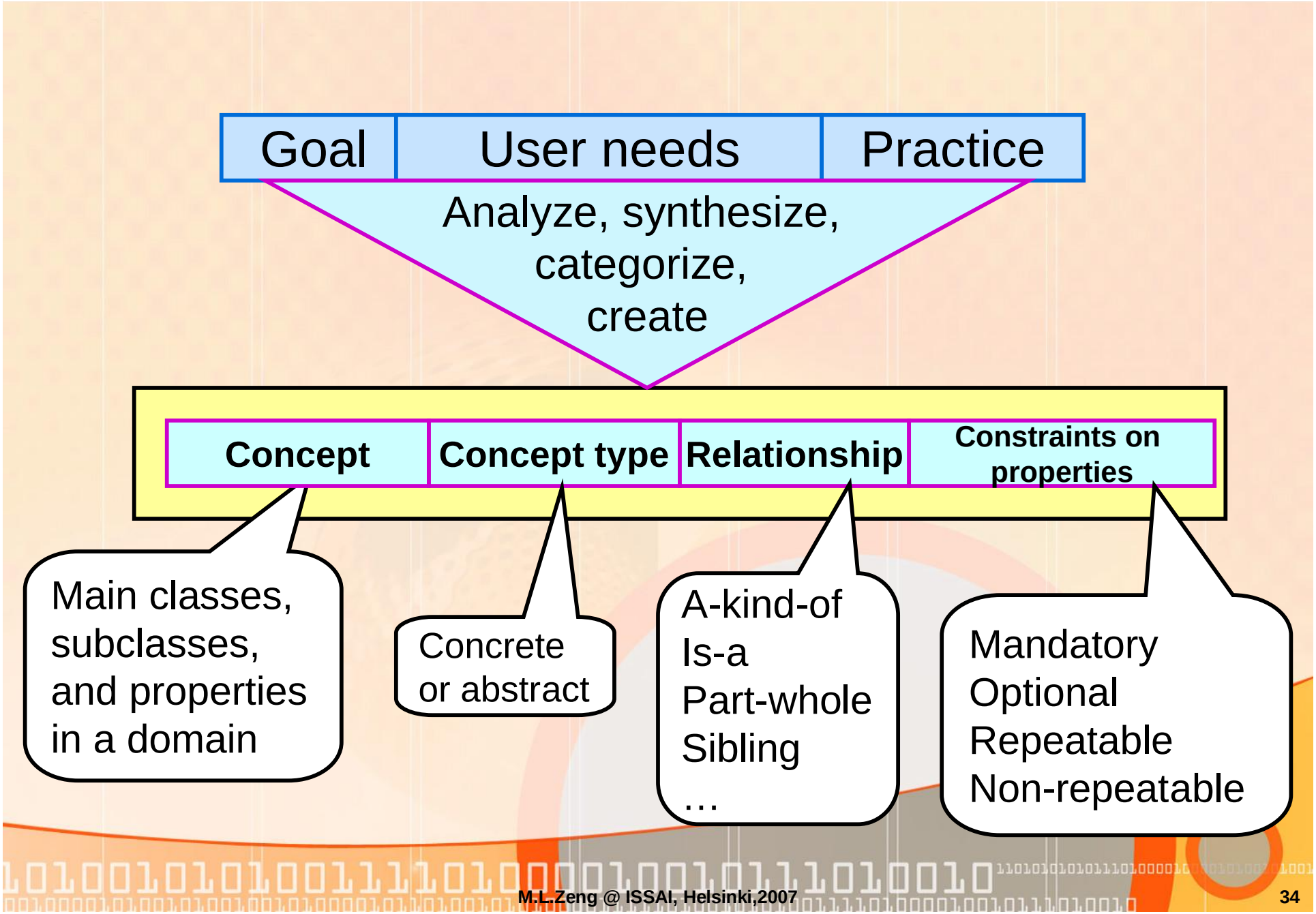
See this page in RDF

http://www.mindswap.org/dav/images/01182006.jpg

Internet

start M... 3 I 2 I 2 I pr... Pr... IA... Al... EN 3:36 PM

# Modeling concepts and relationships



# Where are the major differences

## Functions and components

- Eliminating **ambiguity**
- Controlling **synonyms** or equivalents
- Presenting explicit semantic **relationships**
  - Hierarchical relationships
  - Hierarchical + other associate relationships
- Presenting **properties and attributes** of concepts

| Classifi-cation | Thesaurus | Ontology |
|---|---|---|
| X | X | X |
| X | X | X |
| | | |
| | | |
| | | |
| X | X | X |
| | X | X |
| | | X |

# Where are the major differences

## Expression and encoding

***Machine processable***

***Machine readable***

**Classification**

- Implicit format

T**hesaurus**

- Database
- HTML

XML, RDF, SKOS

***Machine processable***

**Ontology**

- OWL
- RDF
- XML

Revised based on Qin, 2007

# Where are the major differences

## Primary Purposes

**Classification**

- organizing library materials

T**hesaurus**

- Controlled vocabulary for representing topics in indexing and searching

**Ontology**

- Conceptual model for a knowledge and/or application domain

**Still needed? YES**
**Can be reused for ontology ? YES**
**Can be re-purposed ? YES**

Revised based on Qin, 2007


Swoogle Semantic Web Search Engine - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Address http://swoogle.umbc.edu/
Go
Google swoogle Go Bookmarks 528 blocked Check AutoLink Settings
Back Search Favorites
Want more results? Login
Swoogle
semantic web search
2007
ontology document term more >>
Swoogle Search
Searching over 10,000 ontologies
Searching ontologies
manual o news o faq o web-service o submit-url o sw-archive o feedback o swoogle2005
Swoogle © 2004-2007, ebiquity group at UMBC
This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 2.5 License.
Internet
start
2 Windo...
3 Micros...
Zeng-abstr...
http://swoogle.umbc.edu/

# References

- *OWL Web Ontology Language Guide*
  - *http://www.w3.org/TR/owl-guide/*
- *Semantic Web activities - OWL*
  - *http://www.w3.org/2004/OWL/*
- ***Ontology Libraries***
  - *SchemaWeb provides a comprehensive directory of RDF schemas and OWL ontologies. http://www.schemaweb.info/default.aspx*
  - *DAML Ontology Library which organizes hundreds of ontologies in a variety of different ways (keyword, organization, submission date, etc.)*
  - *Swoogle is a search engine for Semantic Web documents, including OWL ontologies.*
  - *BioPortal http://www.bioontology.org/ncbo/faces/pages/ontology_list.xhtml*